REMARKS

Claims 16, 19-40, 44-45 are pending in the application; claims 31-40 are withdrawn from consideration; claims 44 and 45 have been added.

Claim Objection

Claim 21 has been corrected in that it now depends from claim 20.

Also, in claims 19 and 24 spelling errors that have come to the attention of the undersigned have been corrected.

Claim Rejections - 35 U.S.C. 112

Claims 16, 19-30 stand rejected under 35 U.S.C. 112, 2nd paragraph, as being indefinite. The examiner states that the claims set forth "collagen, collagen derivatives" and later composites of collagen and collagen derivatives. In examiner's opinion the term "collagen derivatives" would appear to encompass the composites.

Applicant respectfully disagrees.

Derivatives are compounds that are formed from a similar compound by replacing one atom with another atom or a group of atoms. See attached copy of *Wikipedia* on *Derivative (chemistry)* - 1 page.

Composites are engineered materials of two or more constituents that differ with regard to their physical or chemical properties. See attached copy of *Wikipedia* on *Composite material* - 7 pages.

Thus, a collagen derivative is a chemically modified collagen while a composite as claimed comprises collagen or a collagen derivative and other substances.

The claim language is therefore definite since a chemical derivative does not encompass a composite.

Reconsideration and withdrawal of the rejection of the claims under 35 USC 112 are therefore respectfully requested.

ALLOWABLE SUBJECT MATTER

As stated in the last office action, correction of the misnumbered claims (wrong dependency) and correction of the issue in regard to derivative/composite would place the

application into condition.

It is believed that the issues have been resolved and that therefore the claims are in allowable form.

New claims 44 and 45 have been added that depend from claim 16 and claim 22 and define specific composites.

Since the claims 31 to 40 include the features of the allowable claim 20, rejoinder of the these claims is respectfully requested.

CONCLUSION

In view of the foregoing, it is submitted that this application is now in condition for allowance and such allowance is respectfully solicited.

Should the Examiner have any further objections or suggestions, the undersigned would appreciate a phone call or **e-mail** from the examiner to discuss appropriate amendments to place the application into condition for allowance.

Authorization is herewith given to charge any fees or any shortages in any fees required during prosecution of this application and not paid by other means to Patent and Trademark Office deposit account 50-1199.

Respectfully submitted on October 1, 2008,

/Gudrun E. Huckett/

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GEH
Encl: *Wikipedia - Derivatives; Wikipedia - Composite material*

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Derivative (chemistry)

From Wikipedia, the free encyclopedia

In chemistry, a **derivative** is a compound that is formed from a similar compound *or* a compound that can be imagined to arise from another compound, if one atom is replaced with another atom or group of atoms.[1] The latter definition is common in organic chemistry. In biochemistry, the word is used about compounds that at least theoretically can be formed from the precursor compound.[2]

Chemical derivatives may be used to facilitate analysis. For example, melting point (MP) analysis can assist in identification of many organic compounds. A crystalline derivative may be prepared, such as a semicarbazone or 2,4-dinitrophenylhydrazone (derived from aldehydes/ketones), as a simple way of verifying the identity of the original compound, assuming that a table of derivative MP values is available.[3] Prior to the advent of spectroscopic analysis, such methods were widely used.

See also

- Derivatization

References

1. ^ "Definition of Derivative (http://www.chemicool.com/definition/derivative.html) ". Chemicool (2007-09-18). Retrieved on 2007-09-18.
2. ^ *Oxford Dictionary of Biochemistry and Molecular Biology*. Oxford University Press. ISBN 0-19-850673-2.
3. ^ Williamson, Kenneth L. (1999). *Macroscale and Microscale Organic Experiments, 3rd ed.*. Boston: Houghton-Mifflin, 426-7. ISBN 0-395-90220-7.

Retrieved from "http://en.wikipedia.org/wiki/Derivative_(chemistry)"
Categories: Chemical compounds

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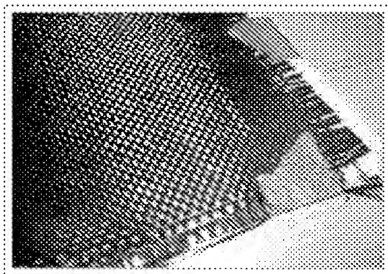
Composite material

From Wikipedia, the free encyclopedia

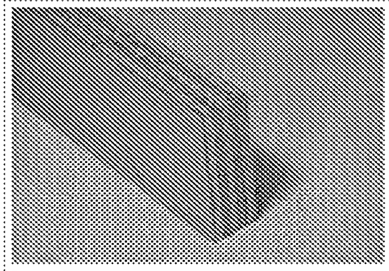
Composite materials (or **composites** for short) are engineered materials made from two or more constituent materials with significantly different physical or chemical properties and which remain separate and distinct on a macroscopic level within the finished structure.



A cloth of woven carbon fiber filaments, a common element in composite materials

Contents

Background



Plywood is a common composite material that many people encounter in their everyday lives

The most primitive composite materials comprised straw and mud in the form of bricks for building construction; the Biblical book of Exodus speaks of the Israelites being oppressed by Pharaoh, by being forced to make bricks without straw being provided. The ancient brick-making process can still be seen on Egyptian tomb paintings in the Metropolitan Museum of Art[1] (http://www.gnmagazine.org/issues/gn09/gn97ma.pdf) . The most advanced examples perform routinely on spacecraft in demanding environments. The most visible applications pave our roadways in the form of either steel and aggregate reinforced portland cement or asphalt concrete. Those composites closest to our personal hygiene form our shower stalls and bath tubs made of fiberglass. Solid surface, imitation granite and cultured marble sinks and counter tops are widely used to enhance our living experiences.

There are two categories of constituent materials: matrix and reinforcement. At least one portion of each type is required. The matrix material surrounds and supports the reinforcement materials by maintaining their relative positions. The reinforcements impart their special mechanical and physical properties to enhance the matrix properties. A synergism produces material properties unavailable from the individual constituent materials, while the wide variety of matrix and strengthening materials allows the designer of the product or structure to choose an optimum combination. Engineered composite materials must be formed to shape. The matrix material can be introduced to the reinforcement before or after the reinforcement material is placed into the mold cavity or onto the mold surface. The matrix material experiences a melding event, after which the part shape is essentially set. Depending upon the nature of the matrix material, this melding event can occur in various ways such as chemical polymerization or solidification from the melted state.

A variety of molding methods can be used according to the end-item design requirements. The principal factors impacting the methodology are the natures of the chosen matrix and reinforcement materials. Another important factor is the gross quantity of material to be produced. Large quantities can be used to justify high capital expenditures for rapid and automated manufacturing technology. Small production quantities are accommodated with lower capital expenditures but higher labor and tooling costs at a correspondingly slower rate. Most commercially produced composites use a polymer matrix material often called a resin solution. There are many different polymers available depending upon the starting raw ingredients. There are several broad categories, each with numerous variations. The most common are known as polyester, vinyl ester, epoxy, phenolic, polyimide, polyamide, polypropylene, PEEK, and others. The reinforcement materials are often fibers but also commonly ground minerals. The various methods described below have been developed to reduce the resin content of the final product, or the fibre content is increased. As a rule of thumb hand lay up results in a product containing 60% resin and 40% fibre, whereas vacuum infusion gives a final product with 40% resin and 60% fibre content. The strength of the product is greatly dependent on this ratio, so this increase in fibre content results in a dramatically stronger product.

Moulding methods

In general, the reinforcing and matrix materials are combined, compacted and processed to undergo a melding event. After the melding event, the part shape is essentially set, although it can deform under certain process conditions. For a thermoset polymeric matrix material, the melding event is a curing reaction that is initiated by the application of additional heat or chemical reactivity such as an organic peroxide. For a thermoplastic polymeric matrix material, the melding event is a solidification

from the melted state. For a metal matrix material such as titanium foil, the melding event is a fusing at high pressure and a temperature near the melt point.

For many molding methods, it is convenient to refer to one mold piece as a "lower" mold and another mold piece as an "upper" mold. Lower and upper refer to the different faces of the molded panel, not the mold's configuration in space. In this convention, there is always a lower mold, and sometimes an upper mold. Part construction begins by applying materials to the lower mold. Lower mold and upper mold are more generalized descriptors than more common and specific terms such as male side, female side, a-side, b-side, tool side, bowl, hat, mandrel, etc. Continuous manufacturing processes use a different nomenclature.

The molded product is often referred to as a panel. For certain geometries and material combinations, it can be referred to as a casting. For certain continuous processes, it can be referred to as a profile.

Open moulding

A process using a rigid, one sided mould which shapes only one surface of the panel. The opposite surface is determined by the amount of material placed upon the lower mould. Reinforcement materials can be placed manually or robotically. They include continuous fibre forms fashioned into textile constructions and chopped fibre. The matrix is generally a resin, and can be applied with a pressure roller, a spray device or manually. This process is generally done at ambient temperature and atmospheric pressure. Two variations of open moulding are Hand Layup and Spray-up.

Vacuum bag moulding

A process using a two-sided mould set that shapes both surfaces of the panel. On the lower side is a rigid mould and on the upper side is a flexible membrane or vacuum bag. The flexible membrane can be a reusable silicone material or an extruded polymer film. Then, vacuum is applied to the mould cavity. This process can be performed at either ambient or elevated temperature with ambient atmospheric pressure acting upon the vacuum bag. Most economical way is using a venturi vacuum and air compressor or a vacuum pump.

Pressure bag moulding

This process is related to vacuum bag moulding in exactly the same way as it sounds. A solid female mould is used along with a flexible male mould. The reinforcement is place inside the female mould with just enough resin to allow the fabric to stick in place. A measured amount of resin is then liberally brushed indiscriminately into the mould and the mould is then clamped to a machine that contains the male flexible mould. The flexible male membrane is then inflated with heated compressed air or possibly steam. The female mould can also be heated. Excess resin is forced out along with trapped air. This process is extensively used in the production of composite helmets due to the lower cost of unskilled labor. Cycle times for a helmet bag moulding machine vary form 20 to 45 minutes, but the finished shells require no further curing if the moulds are heated.

Autoclave moulding

A process using a two-sided mold set that forms both surfaces of the panel. On the lower side is a rigid mold and on the upper side is a flexible membrane made from silicone or an extruded polymer film such as nylon. Reinforcement materials can be placed manually or robotically. They include continuous fiber forms fashioned into textile constructions. Most often, they are pre-impregnated

with the resin in the form of prepreg fabrics or unidirectional tapes. In some instances, a resin film is placed upon the lower mold and dry reinforcement is placed above. The upper mold is installed and vacuum is applied to the mold cavity. The assembly is placed into an autoclave pressure vessel. This process is generally performed at both elevated pressure and elevated temperature. The use of elevated pressure facilitates a high fiber volume fraction and low void content for maximum structural efficiency.

Resin transfer moulding (RTM)

A process using a two-sided mold set that forms both surfaces of the panel. The lower side is a rigid mold. The upper side can be a rigid or flexible mold. Flexible molds can be made from composite materials, silicone or extruded polymer films such as nylon. The two sides fit together to produce a mold cavity. The distinguishing feature of resin transfer molding is that the reinforcement materials are placed into this cavity and the mold set is closed prior to the introduction of matrix material. Resin transfer molding includes numerous varieties which differ in the mechanics of how the resin is introduced to the reinforcement in the mold cavity. These variations include everything from vacuum infusion (see also resin infusion) to vacuum assisted resin transfer molding. This process can be performed at either ambient or elevated temperature.

Other

Other types of molding include press molding, transfer molding, pultrusion molding, filament winding, casting, centrifugal casting and continuous casting.

Tooling

Some types of tooling materials used in the manufacturing of composites structures include invar, steel, aluminum, reinforced silicon rubber, nickle, and carbon fiber. Selection of the tooling material is typically based on, but not limited to, the coefficient of thermal expansion, expected number of cycles, end item tolerance, desired or required surface condition, method of cure, glass transition temperature of the material being molded, molding method, matrix, cost and a variety of other considerations.

Mechanics of composite materials

The physical properties of composite materials are generally not isotropic (independent of direction of applied force) in nature, but rather are typically orthotropic (different depending on the direction of the applied force or load). For instance, the stiffness of a composite panel will often depend upon the orientation of the applied forces and/or moments. Panel stiffness is also dependent on the design of the panel. For instance, the fiber reinforcement and matrix used, the method of panel build, thermoset versus thermoplastic, type of weave, and orientation of fiber axis to the primary force.

In contrast, isotropic materials (for example, aluminium or steel), in standard wrought forms, typically have the same stiffness regardless of the directional orientation of the applied forces and/or moments.

The relationship between forces/moments and strains/curvatures for an isotropic material can be described with the following material properties: Young's Modulus, the Shear Modulus and the Poisson's ratio, in relatively simple mathematical relationships. For the anisotropic material, it

requires the mathematics of a second order tensor and up to 21 material property constants. For the special case of orthogonal isotropy, there are three different material property constants for each of Young's Modulus, Shear Modulus and Poisson's ratio--a total of 9 constants to describe the relationship between forces/moments and strains/curvatures.

Categories of fiber reinforced composite materials

Fiber reinforced composite materials can be divided into two main categories normally referred to as short fiber reinforced materials and continuous fiber reinforced materials. Continuous reinforced materials will often constitute a layered or laminated structure. The woven and continuous fiber styles are typically available in a variety of forms, being pre-impregnated with the given matrix (resin), dry, uni-directional tapes of various widths, plain weave, harness satins, braided, and stitched.

The short and long fibers are typically employed in compression molding and sheet molding operations.These come in the form of flakes, chips, and random mate (which can also be made from a continuous fiber laid in random fashion until the desired thickness of the ply / laminate is achieved).

Failure of composites

Shock, impact, or repeated cyclic stresses can cause the laminate to separate at the interface between two layers, a condition known as delamination. Individual fibers can separate from the matrix e.g. fiber pull-out.

Composites can fail on the microscopic or macroscopic scale. Compression failures can occur at both the macro scale or at each individual reinforcing fiber in compression buckling. Tension failures can be net section failures of the part or degradation of the composite at a microscopic scale where one or more of the layers in the composite fail in tension of the matrix or failure the bond between the matrix and fibers.

Some composites are brittle and have little reserve strength beyond the initial onset of failure while others may have large deformations and have reserve energy absorbing capacity past the onset of damage. The variations in fibers and matrices that are available and the mixtures that can be made with blends leave a very broad range of properties that can be designed into a composite structure. The best known failure occurred when the carbon-fiber wing of the Space Shuttle Columbia fractured when impacted during take-off. It led to catastrophic break-up of the vehicle when it re-entered the earth's atmosphere on February 1, 2003.

Examples of composite materials

Fiber reinforced polymers or FRPs include wood (comprising cellulose fibers in a lignin and hemicellulose matrix), carbon-fiber reinforced plastic or CFRP, and glass reinforced plastic or GRP. If classified by matrix then there are thermoplastic composites, short fiber thermoplastics, long fiber thermoplastics or long fiber reinforced thermoplastics. There are numerous thermoset composites, but advanced systems usually incorporate aramid fibre and carbon fibre in an epoxy resin matrix.

Composites can also use metal fibres reinforcing other metals, as in metal matrix composites or MMC. Magnesium is often used in MMCs because it has similar mechanical properties as epoxy. The benefit of magnesium is that it does not degrade in outer space. Ceramic matrix composites include bone (hydroxyapatite reinforced with collagen fibers), Cermet (ceramic and metal) and concrete.

Ceramic matrix composites are built primarily for toughness, not for strength. Organic matrix/ceramic aggregate composites include asphalt concrete, mastic asphalt, mastic roller hybrid, dental composite, syntactic foam and mother of pearl. Chobham armour is a special composite used in military applications.

Additionally, thermoplastic composite materials can be formulated with specific metal powders resulting in materials with a density range from 2 g/cc to 11 g/cc (same density as lead). These materials can be used in place of traditional materials such as aluminum, stainless steel, brass, bronze, copper, lead, and even tungsten in weighting, balancing, vibration dampening, and radiation shielding applications. High density composites are an economically viable option when certain materials are deemed hazardous and are banned (such as lead) or when secondary operations costs (such as machining, finishing, or coating) are a factor.

Engineered wood includes a wide variety of different products such as plywood, oriented strand board, wood plastic composite (recycled wood fiber in polyethylene matrix), Pykrete (sawdust in ice matrix), Plastic-impregnated or laminated paper or textiles, Arborite, Formica (plastic) and Micarta. Other engineered laminate composites, such as Mallite, use a central core of end grain balsa wood, bonded to surface skins of light alloy or GRP. These generate low-weight, high rigidity materials.

Typical products

Composite materials have gained popularity (despite their generally high cost) in high-performance products that need to be lightweight, yet strong enough to take harsh loading conditions such as aerospace components (tails, wings, fuselages, propellers), boat and scull hulls, bicycle frames and racing car bodies. Other uses include fishing rods and storage tanks. The new Boeing 787 Dreamliner structure including the wings and fuselage is composed of over 50 percent composites.

Carbon composite is a key material in today's launch vehicles and spacecrafts. It is widely used in solar panel substrates, antenna reflectors and yokes of spacecrafts. It is also used in payload adapters, inter-stage structures and heat shields of launch vehicles.

Resins

Typically, most common composite materials, including fiberglass, carbon fiber, and kevlar, include at least two parts, the substrate and the resin.

Polyester resin, tends to have yellowish tint, and is sutable for most backyard projects. It weaknesses are that it is UV sensitive and can tend to degrade over time, and thus generally is also coated to help preserve it. It is often used in the making of surfboards and for marine applications. Its hardener is a MEKH, and is mixed at 14 drops per oz. MEKP is composed of methyl ethyl ketone peroxide, a catalyst. When MEKP is mixed with the resin, the resulting chemical reaction causes heat to build up and cure or harden the resin.

Vinylester resin, tends to have a purplish to bluish to greenish tint. This resin has lower viscosity than polyester resin, and is more transparent. This resin is often billed as being fuel resistant, but will melt in contact with gasoline. This resin tends to be more resistant over time to degradation than polyester resin, and is more flexible. It uses the same hardener as polyester resin (at the same mix ratio) and the cost is approximately the same.

Epoxy resin is almost totally transparent when cured. In the aerospace industry, epoxy is used as a

structural matrix material or as a structural glue.

See also

- Alloy
- Fibre
- Polymer
- Thermoplastic
- Thermoset
- Reinforced concrete
- Fiber reinforced concrete
- Short Fiber Reinforced Blends
- Aluminium composite panel
- American Composites Manufacturers Association

References

Further reading

- Autar K. Kaw (2005). *Mechanics of Composite Materials*, 2nd edition, CRC. ISBN 0-84-931343-0.
- Handbook of Polymer Composites for Engineers By Leonard Hollaway Published 1994

Woodhead Publishing

External links

- Composite material key concepts (http://www.science.org.au/nova/059/059key.htm)
- Distance learning course in polymers and composites (http://www3.open.ac.uk/courses/bin/p12.dll?C01T838)
- Composite Sandwich Structure of Minardi F1 Car (http://www.nenastran.com/newnoran/chPDF/CASE_Chassis_Design.pdf)
- Teaching support materials for the University of Plymouth composites degree (http://www.tech.plym.ac.uk/smc/mats324/)
- Platform for integrated simulation of composite real-life behaviour (http://www.composite-agency.com)

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